

Pioneering a Biobased UAS

The Stanford-Brown-Spelman 2014 iGEM team

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With the exponential growth of interest in unmanned aerial vehicles (UAVs) and their vast array of applications in both space exploration and terrestrial uses such as the delivery of medicine and monitoring the environment, the 2014 Stanford-Brown-Spelman iGEM team is pioneering the development of a fully biological UAV for scientific and humanitarian missions. The prospect of a biologically-produced UAV presents numerous advantages over the current manufacturing paradigm. First, a foundational architecture built by cells allows for construction or repair in locations where it would be difficult to bring traditional tools of production. Second, a major limitation of current research with UAVs is the size and high power consumption of analytical instruments, which require bulky electrical components and large fuselages to support their weight. By moving these functions into cells with biosensing capabilities – for example, a series of cells engineered to report GFP, green fluorescent protein, when conditions exceed a certain threshold concentration of a compound of interest, enabling their detection post-flight – these problems of scale can be avoided. To this end, we are working to engineer cells to synthesize cellulose acetate as a novel bioplastic, characterize biological methods of waterproofing the material, and program this material's systemic biodegradation. In addition, we aim to use an “amberless” system to prevent horizontal gene transfer from live cells on the material to microorganisms in the flight environment. So far, we have: successfully transformed *Gluconacetobacter hansenii*, a cellulose-producing bacterium, with a series of promoters to test transformation efficiency before adding the acetylation genes; isolated protein bands present in the wasp nest material; transformed the cellulose-degrading genes into *Escherichia coli*; and we have confirmed that the amberless construct prevents protein expression in wild-type cells. In addition, as part of our human outreach project, we have been in touch with leaders in the fields of UAVs, synthetic biology, and earth sciences, and it is clear that biodegradable UAVs could have a significant impact on the industry.